Foulger Pratt

1355 Piccard Drive, Suite 400

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**Attention:** Jack Clagett

**SUBJECT:** **Exterior Evaluation**

*Silver Spring Metro Center - Buildings 2, 3, & 4*

*Silver Spring, Maryland*

FEA Project No. 00.2040

Facility Engineering Associates, P.C. (FEA) has completed the exterior evaluation as outlined in our Proposal dated March 8, 2000 and authorized on March 14, 2000.

We have included the following sections in this report:

- A review of **Project Background** information
- A brief review of our **Scope of Work**
- Our **Observations**
- **Recommendations** for repairs
- Our **Opinion of Cost** for the recommended repairs
- Report **Summary**
- **Appendices** (photographs and drawings)

After your review of this evaluation, FEA can develop Construction Documents, assist the Owner during the Bidding Phase, and perform Construction Administration services during repairs. Please contact us with questions or comments regarding this report.

Very truly yours,

**FACILITY ENGINEERING ASSOCIATES, P.C.**

Erik R. Valentino                                                                                    Daniel L. Watkins, P.E.

Project Engineer                                                                                    Project Manager

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**APPENDICES**



# 1.0 PROJECT BACKGROUND

Foulger Pratt developed Building 2 in 1990 and buildings 3 and 4 at the Silver Spring Metro Center in 1993. Buildings 2, 3, and 4 (1325, 1315, and 1305 East-West Highway, respectively) have had recent water infiltration through the building exterior. The water infiltration has been reported at numerous locations at the buildings. Also at Building 3, water entry has been reported at the fitness center area on the M2 level.

Building 2 is 18 stories, Building 3 is 15 stories, and Building 4 is 13 stories in height. Each of the three buildings were constructed with a reinforced concrete structural frame. The lower floors of Buildings 3 and 4 were constructed with a brick masonry facade; Building 2 and the upper floors of Buildings 3 and 4 were constructed with a precast concrete curtain wall. A terrace was constructed above the M2 level fitness center space at Building 3. The terrace was constructed with precast concrete pavers over a sand setting bed and waterproofing membrane. The buildings have aluminum framed, insulated glass window systems. Buildings 3 and 4 have similar fixed window systems and Building 2 has a ribbon window system.

# 2.0 SCOPE OF WORK

We performed the following Scope of Work at Buildings 2, 3, and 4 of the Silver Spring Metro Center.

Evaluation

**2.1 Document Review -** We reviewed available design drawings to observe construction details, obtain dimensions, and identify building exterior construction methods. The following drawings were reviewed:

· Building 2: Architectural by Bucher Meyers Polniaszek Silkey dated May 1987.

Window System Shop Drawings by Service Glass Industries dated April 1988.

· Building 3: Architectural by Bucher Meyers Polniaszek Silkey dated May 1990.

Window System Shop Drawings by Custom Walls & Windows dated March 1991.

· Building 4: Architectural by Bucher Meyers Polniaszek Silkey dated June 1991.

Window System Shop Drawings by Custom Walls & Windows dated April 1992.

We also spoke to on-site personnel to obtain additional information regarding previous repairs, deficiencies, and maintenance.

**2.2 Documentation of Leaks -** We discussed the building leak history with on-site personnel and documented the interior conditions at the reported leak locations. We coordinated exterior observations and leak test locations with areas of reported leaks.

**2.3 Visual Evaluation -** We conducted a visual evaluation of the exterior elevations of the buildings including the masonry wall systems, M2 Level terrace, and window systems. The purpose of the visual evaluation was to determine the general condition of the masonry, flexible sealants, precast panels, window systems, flashings and related details, and establish leak locations and correlate those locations with exterior construction. The exterior evaluation was conducted from the ground, from the roof, and from swing stage scaffold. Simpson Unlimited, Inc. supplied the swing stage to access a total of six different elevations during six separate drops, two drops at each of the three buildings. During our visual evaluation from the swing stage scaffold, we also looked for any potential signs of distress caused from vibration from trains on the railroad tracks adjacent to the property.

**2.4** **Exterior Finish Removal -** We removed brick at two locations at reported leak locations at the Building 3 fitness center area to document construction and determine the presence and condition of flashing and the wall cavity. The pavers and sand setting bed at the 1st floor terrace above the fitness center were removed in two selected locations to observe condition of the waterproofing membrane and flashing.

**2.5** **Leak Testing -** We performed limited leak testing to further evaluate exterior deficiencies. Leak testing consisted of spraying the exterior surfaces with an ASTM-approved nozzle in general accordance with American Architectural Manufacturers Association (AAMA) leak testing procedures.

**2.6** **Report -** We have provided this written report of the evaluation, including the following:

- A summary of our observations and leak testing.
- Recommendations regarding repairs.
- Our Opinion of Cost for the repairs and associated engineering services.
- Photographs of representative conditions.
- Sketches outlining certain findings.

# 3.0 OBSERVATIONS

FEA conducted field evaluation and leak testing of the building exteriors during numerous site visits in April 2000. The visual observations were made from the ground, roof, and swing stage drops at the building exterior. Our assessment of the building exterior was primarily based on close proximity observations made during the six swing stage drops and observations made from the terrace levels; the drop locations are illustrated in *Appendix B: Drawings*. Simpson Unlimited, Inc. was contracted to provide the rigging and swing stage access. We also accessed the interior of various suites for general observations and during leak testing.

We met with the following Foulger Pratt representatives: Mr. Ken Leslie (Director of Engineering), Mr. Tu Vinh (Building 2 Engineer), Mr. Dave Macomber (Building 3 Engineer), and Mr. Juan Barrera (Building 4 Engineer) for information about the property, previous repairs, and reported leaks. Pictures and descriptions of typical conditions may be viewed in *Appendix A: Photographs.* The following is a summary of our observations.

## 3.1 Building 2

**Leaks -** We understand that random leaks have occurred throughout the building, typically manifesting as stained ceiling tiles, some damaged drywall, and residue on glass. We were not informed of any leaks at the storefront areas. It was indicated that sustained, wind-driven rains generate the most leaks at the building. Some leaks may experience a delay of up to approximately 24 hours from the time of a rainstorm to become visible on the interior due to the path of entry.

**Previous Repairs -** Foulger Pratt reported that the majority of the precast-to-metal and precast-to-precast sealants were re-sealed approximately five years ago with polyurethane sealant, but the removal and preparation procedures for the repairs are unknown. Sealant repairs in response to reported leaks has been performed and some leaks have been stopped. Sealant has been applied to the corners of several of the glass-to-metal glazing gaskets and over precast panel cracks. Weep holes were drilled in many of the horizontal mullions; however, we were unable to determine when this occurred.

**Precast-to-Precast Sealants -** The sealants between precast panels were deteriorated at some areas. The sealant was cracked, overshot with new sealant, degraded by ultraviolet exposure, and open. The precast-to-precast joint sealants were generally in poor to fair condition.

**Precast-to-Metal Sealants - The joint sealants between the precast panels and metal window frames were deteriorated in some areas. Holes in the sealant created by loss of adhesion and general deterioration were observed. New sealant was applied over old sealant and had begun to separate at various locations. Upon pressing the sealant joint, we observed water coming out from behind the sealant at some areas. The building precast-to-metal joint sealants were generally in poor to fair condition.**

**Glass-to-Metal Gaskets/Sealants -** The glazing gaskets between the glass and the metal frame were original. Some areas were repaired by cutting the glazing gaskets back and wet glazing the windows. Several areas were wet glazed in the corners only, apparently to seal the joint where the glazing gasket had pulled away from the frame. Based on our observations at two drops on the building, we estimate that approximately 15% to 20% of the gaskets were observed to be pulling away from the frame, mis-aligned, and cracked and deteriorated. The gaskets were generally in poor to fair condition.

**Window Frame System -** The window mullion and frame system was pre-finished bronze aluminum and no significant deterioration was observed. Some minor nicks and scratches were observed on the metal frame. The window system was soiled with dirt and atmospheric pollution.

**Precast Panels -** The panels had a cast drip edge to prevent water from rolling back toward the building. Cracks were observed in the precast panels at various random locations on the interior and exterior. The cracks appeared on the face, sill, and head of the panels. No significant delamination or spalling of the concrete panels was observed. Some of the cracks were surface sealed with flexible sealant. One crack was observed at the lift point of the panel. The crack at the lift point was observed to continue from the interior through to the exterior of the panel.

**Weep Provisions -** It appears that no weep provisions were incorporated into the original window system. At some point and at many locations on the building, weep holes were drilled into the center of the lower horizontal mullion. The drilled weeps appeared to function as intended, since water was observed exiting the weeps and there was no evidence of weeps allowing water to enter the building.

**Other -** The ground level storefront systems on the building were observed and did not appear to have any significant deficiencies. Flexible sealant was applied to the butt joints between horizontal and vertical window framing members.

**Summary -** Flexible sealants at the building were deteriorated at some areas. The deteriorated sealant was cracked, open, and overshot with new sealant. The sealant also showed signs of loss of adhesion and ultraviolet degradation. Some areas of the sealants were chalked. The building sealants were generally polyurethane based except for silicone at the wet-glazed areas. It appears that water breaches the building envelope at deteriorated sealant joints and panel cracks.

## 3.2 Building 3

**Leaks -** We understand that random leaks have occurred throughout the building, typically manifesting as stained drywall or water dripping from the interior metal window frame. We were not informed of any leaks at the storefront areas. It was indicated that sustained, wind-driven rains generate the most leaks at the building. It was noted that numerous leaks at the wall, window, and floor are present at the fitness center. Some leaks may experience a delay of up to approximately 24 hours from the time of a rainstorm to become visible on the interior due to the path of entry.

**Previous Repairs -** Sealant repairs in response to reported leaks has been performed and some leaks have been stopped. Numerous windows had the glazing gasket removed and the glass-to-metal joint wet glazed. Sealant has been applied over precast panel cracks at numerous locations. Masonry repairs consisting of brick replacement and the installation of a through-wall flashing above the fitness center windows was completed previously. Flashing repairs and the installation of a metal cap over the cast stone coping have been performed in the area directly outside the fitness center.

**Precast-to-Precast Sealants -** The sealants between precast panels were deteriorated at some areas. The sealant was cracked, chalked, degraded by unltraviolet exposure, and open. The precast-to-precast joint sealants were generally in fair condition.

**Precast-to-Metal Sealants - The joint sealants between the precast panels and metal window frames were deteriorated in some areas. Holes in the sealant created by loss of adhesion, failure of a butt joint between new and existing sealant, and general deterioration were observed. The building precast-to-metal joint sealants were generally in poor to fair condition.**

**Glass-to-Metal Gaskets/Sealants -** The glazing gaskets between the glass and the metal frame were original. Several areas were repaired by cutting the glazing gasket back or removing the gasket and wet glazing the windows. Some of the wet glazed joints were larger than necessary. The condition of wet glazed areas varied from fair to good, based on the size and tooling of the joint. Based on our observations at two drops on the building, we estimate that approximately 10% to 15% of the gaskets were observed mis-aligned and deteriorated. The gaskets were generally in poor to fair condition. The window detail is such that if the gaskets are cut back or removed, the glass needs to be supported or it will shift outward in the frame. When wet glazing these windows, silicone or similar wedges should be placed between the glass and metal prior to gasket removal.

**Window Frame System -** The window system used for this building appears to be a modified storefront system that is typically not used in mid-rise buildings. The main difference between the existing system versus a commercial fixed window system is that the existing sub-sill, end dams, rear dams, and continuous weep would not be used in a fixed window application. The fixed window application would incorporate a drainage well in the sill frame that weeps through small weep holes that are less affected by wind. Based on visual observations, the sub-sill was not found to slope inward. The window frame system was pre-finished almond painted aluminum and no significant deterioration was observed. Some minor nicks and scratches were observed on the metal frame. The window system was soiled with dirt and atmospheric pollution.

**Precast Panels -** The panels did not have a drip edge at the top of the windows to prevent water from rolling back toward the interior of the building. Cracks were observed in the precast panels at various random locations on the interior and exterior of the building. The cracks appeared on the face, sill, and head of the panels. Cracking was prevalent at either side of the sill and at corners of the panel face propagating outward at approximately 45 degrees. Based on information provided to us and size and location of the cracks, it appears that the cracks were present before installation or as a result of installation. Although a certain amount of minor cracking is anticipated, there are numerous cracks beyond anticipated amounts on the building. Some of these cracks may allow water to migrate into the building. Some of the cracks were surface sealed with flexible sealant. No significant delamination or spalling of the concrete panels was observed.

**Weep Provisions -** The window sub-sill is mounted to the precast panel and then the frame is mounted to the sub-sill. The sub-sill has an integrated back dam with end dams field -installed on each side. The sub-sill and dams are intended to direct water back out the front 1/32-inch weep slit between the sub-sill and window frame. Additionally, the vertical members of the window frame are cut 1/16 inch short at the sill to allow a larger weep area. We observed several weep slits that had become clogged with dirt and some that had been sealed with flexible sealant. The end dams were set in a bed of sealant and back sealed during construction, but we found that in two areas a metal stud was secured into the end dam with a ½-inch self-tapping screw after the windows were installed. This screw caused the end dam to be pulled out of alignment and not function as intended. The extent of the damage from the screw in the end dams is unknown. The weeps appeared not to function as intended, due to the various deficiencies and allowed water to enter the building. Illustrations of the window details can be seen in *Appendix B: Drawings*.

**Drywall Removal -** Foulger Pratt removed a section of drywall around the bottom and sides of one window for FEA to observe and perform a leak test. We observed the mounting and leveling provision for the precast panels, the window sub-sill and frame mounting, and the end dam conditions. We observed ½-inch self-tapping screws attaching a metal wall stud to the end dam on each side of the window. The end dams were visibly displaced from their desired location and stress was placed on the embedding sealant. We were able to visually observe water from the leak test entering the building via the damaged end dams.

**Other -** The ground level storefront systems on the building were observed and did not appear to have any significant deficiencies. Flexible sealant was applied to some of the butt joints between horizontal and vertical window framing members.

**Summary -** Flexible sealants at the building were deteriorated at some areas. The deteriorated sealant was cracked, overshot with new sealant, chalked, and open. The sealant also showed signs of loss of adhesion and ultraviolet degradation. The building sealants were generally polyurethane based except for silicone at the wet-glazed areas. The building joint sealants were generally in fair condition.

It appears that water breaches the building envelope at deteriorated sealant joints, damaged end dams, and precast panel cracks.  Water entering the building at the broken end dams is in close proximity to the drywall.

## 3.3 Fitness Center at Building 3

The following are additional observations made at Building 3 in the fitness center area.

**Brick Masonry Removal -** Simpson Unlimited removed two areas of brick masonry from the exterior walls in the vicinity of leak locations above the windows at the M-2 fitness center for observation.  We observed the steel lintel, PVC through-wall flashing, and termination bar.  We were unable to determine if end dams were in-place, but the flashing material was brittle, which is expected of the PVC material used.  We found that one location of through-wall flashing did not extend to the exterior face of the masonry and did not have an adequate drip edge.  The through-wall flashing was also not adequately sealed and secured to the back-up wall at its top.  Several areas of cracked and deteriorated mortar on the lower level masonry sections of the building were observed.

**1st Floor Terrace Membrane\Paver Removal -** Simpson Unlimited removed pavers, sand setting bed, and drainage board at two locations of the 1st floor terrace above the fitness center for observation.  The membrane had several bubbled areas with water underneath the membrane on the concrete deck.  The flashing at the planter masonry wall was loose and open and had no termination bar.

**Planter Removal -** Foulger Pratt removed a planter tub on the 1st floor terrace for observations.  We found that the sealant around the perimeter of the fiberglass tub flange top and coping stones was deteriorated, there was no waterproofing membrane present in the planter well walls or on the structural deck beneath the tub, and several cracks were observed in the concrete blocks inside the well.  The planter tubs bear on steel studs above the concrete structural deck.  There appeared to be a failed cementitious coating on the bottom two courses of concrete block inside the well.  Directly following the removal of the tub from the well, the concrete block were observed wet inside the well.  It appeared that the construction and deficiencies of the planter wells allows water to penetrate behind and underneath the 1st floor terrace waterproofing membrane, which can migrate down to the M-2 level.

**Summary -** Along with similar deficiencies found on the rest of the building, exploratory observations provided additional insight into how water may infiltrate into the fitness center.  Weep holes were drilled in the some of the window frames at the fitness center, but did not appear to help reduce leaks.  It appears that water may enter the building envelope of the fitness center through a combination of the following:

deteriorated sealant joints, damaged window end dams, inadequate through-wall flashing, 1st floor terrace waterproofing deficiencies, cracked mortar joints, un-waterproofed planter wells, and panel cracks. Water is able to get underneath the 1st floor terrace waterproofing membrane via breaches in the planter masonry wall and flashing openings.

# 3.4 Building 4

We found that observed conditions on building 4 were similar to conditions at Building 3.

**Leaks -** We understand that random leaks have occurred throughout the building, typically manifesting as stained drywall or water dripping from the interior metal window frame. We were not aware of any leaks at the storefront areas. It was indicated that sustained, wind-driven rains generate the most leaks at the building. Some leaks may experience a delay of up to approximately 24 hours from the time of a rainstorm to become visible on the interior due to the path of entry.

**Previous Repairs -** Sealant repairs in response to reported leaks has been performed and some leaks have been stopped. Numerous windows had the glazing gasket removed and the glass-to-metal joint wet glazed. The $12^{th}$ and $15^{th}$ floor, multi-level, arched top windows have been totally wet glazed and re-sealed to address a problem with a failed secondary sealant joint in the sills associated with those windows only. Sealant has been applied over precast panel cracks in many cases.

**Precast-to-Precast Sealants -** The sealants between precast panels were deteriorated at some areas. The sealant was cracked, chalked, degraded by unltraviolet exposure, and open. The precast-to-precast joint sealants were generally in fair condition.

**Precast-to-Metal Sealants - The joint sealants between the precast panels and metal window frames were deteriorated in some areas. Holes in the sealant created by loss of adhesion and general deterioration were observed. The building precast-to-metal joint sealants were generally in poor to fair condition.**

**Glass-to-Metal Gaskets/Sealants -** The glazing gaskets between the glass and the metal frame were original. Several areas were repaired by cutting the glazing gasket back or removing the gasket and wet glazing the windows. Some of the wet glazed joints were larger than necessary. The condition of wet glazed areas varied from fair to good, based on the size and tooling of the joint. Based on our observations at two drops on the building, we estimate that approximately 10% to 15% of the gaskets were observed to be mis-aligned and deteriorated. The gaskets were generally in poor to fair condition. The window detail is such that if the gaskets are cut back or removed, the glass needs to be supported or it will shift outward in the frame. When wet glazing these windows, silicone or similar wedges should be placed between the glass and metal prior to gasket removal.

**Window Frame System -** The window system used for this building appears to be a modified storefront system that is typically not used in mid-rise buildings. The main difference between the existing system versus a commercial fixed window system is that the existing sub-sill, end dams, rear dams, and continuous weep would not be used in a fixed window application. The fixed window application would incorporate a drainage well in the sill frame that weeps through small weep holes that are less affected by the wind. Based on visual observations, the sub-sill was not found to slope inward. The window frame system was pre-finished almond painted aluminum and no significant deterioration was observed. Some minor nicks and scratches were observed on the metal frame. The window system was soiled with dirt and atmospheric pollution.

**Precast Panels -** Certain floors of panels had a cast drip edge to prevent water from rolling back toward the building. Cracks were observed in the precast panels at various random locations on the interior and exterior of the building. The cracks appeared on the face, sill, and head of the panels. Cracking was predominant at either side of the sill and at corners of the panel face propagating outward at approximately 45 degrees. Based on information provided to us by personnel on-site during the time of original construction, and size and location of the cracks, it appears that the cracks were present before installation or as a result of installation. Although a certain amount of minor cracking is anticipated, there are numerous cracks beyond anticipated amounts on the building. Some of the cracks were surface sealed with flexible sealant. No significant delamination or spalling of the concrete panels was observed.

**Weep Provisions -** The window sub-sill is mounted to the precast panel and then the frame is mounted to the sub-sill. The sub-sill has an integrated back dam with end dams field-placed on each side. The sub-sill and dams are intended to direct water back out the front 1/32-inch weep slit between the sub-sill and window frame. Additionally, the vertical members of the window frame were cut 1/16 inch short at the sill to allow a larger weep area. We observed several weep slits that had become clogged with dirt and some that had been sealed with sealant. The end dams were set in a bed of sealant and back sealed during construction. Since no drywall removal was completed in Building 4, we were unable to determine if screws were present in the end dams similar to Building 3. However, the window systems and the leak symptoms are similar. The weeps appeared not to function as intended, due to the various deficiencies and allowed water to enter the building.

**Masonry -** The lower levels of the building have a brick masonry façade and were observed to have cracked and deteriorated mortar joints in several areas. One area near drop location one was noted at a shelf angle supporting the masonry above that the mortar was removed from the joint and the joint was left open. We understand that a flexible sealant soft joint was to be installed.

**Other -** The ground level storefront systems on the building were observed and did not appear to have any significant deficiencies. Some butt joints between horizontal and vertical members of the frame were sealed.

**Summary -** Flexible sealants at the building were deteriorated at some areas. The deteriorated sealant was cracked, chalked, overshot with new sealant, and open. The sealant also showed signs of loss of adhesion and ultraviolet degradation. The building sealants were generally polyurethane based except for silicone at the wet-glazed areas. The building joint sealants were generally in fair condition.

It appears that water breaches the building envelope at deteriorated sealant joints, damaged end dams, cracked mortar joints, and precast panel cracks. Water entering the building at the broken end dams is in close proximity to the drywall.

# 3.5 Leak Testing

Leak testing was conducted at three to seven locations per drop. Two drops were performed on each building. An additional leak test was performed with a spray rig on Building 3 at the location where drywall was opened on the interior. The leak tests were performed on several areas of the window and precast panel system joints and components. The tests were performed using an ASTM pressure regulated nozzle in accordance with the American Architectural Manufacturers Association (AAMA) 501.2-94 "Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage". The water pressure was maintained at approximately 35 pounds per square inch (psi) throughout the duration of the test.

Prior to commencing the leak testing, FEA coordinated with on-site personnel to mark the windows on the interior that had reported leaks. We then correlated leak testing and observations on the exterior with the reported leak locations.

FEA sprayed each component of the façade system for ten to twenty-minute time periods. The spraying was conducted in a manner that isolated each of the components to identify obvious paths of water entry. FEA simultaneously positioned personnel on both the interior and exterior of the facade system during testing to observe and search for leaks.

The majority of our leak tests did not produce leaks during our time on-site. We understand that the day after our leak test in Building 2, stains from a leak were observed; however, we were unable to directly identify the cause of the leak. We were able to generate a leak at a precast panel crack at a lift point on the 5$^{th}$ floor of Building 2. We were also able to generate and observe a leak at the 6$^{th}$ floor of Building 3 where FEA requested the drywall be removed. The leak was at the bottom corners of the window where the end dams were damaged by screws used to install the metal studs. This leak location at the end dams due to the screw is consistent with the drywall damage observed at both Building 3 and 4.

## 3.6 Observations for Possible Vibration Damage

FEA observed the northeast elevations at one drop at each of the three buildings on the side of the railroad tracks. It appears that a combination of freight trains and Metro trains pass the buildings on a regular basis. Based on visual observations only, we did not observe any signs of distress or deterioration at the northeast elevations that may be attributed to vibrations from the trains. The deterioration observed was found randomly on the buildings.

# 4.0 RECOMMENDATIONS

Based on our observations, we have summarized our recommendations in the following sections.

## 4.1 Building 2

**4.2.1 Sealant Replacement -** Building sealants should be removed and replaced with a suitable silicone sealant. Precast-to-precast, precast-to-metal, and glass-to-metal joints should be included. The replacement of sealants is a maintenance item and should be anticipated on a periodic basis. Although some of the glass-to-metal frame gaskets appear to be in fair condition, based upon our observations performed during the drops, we estimate that 15% to 20% of the gaskets do require repair. We recommend that the gaskets needing repair be cut back and the joint sealed with flexible sealant (wet glazed).

**4.2.2 Repair Panel Cracks -** Flexible sealant used to surface seal cracks in the precast panels does not provide a bonded structural repair to fill the crack void. The cracks should be cleaned, prepared, and then epoxy injected to properly repair the crack and prevent advanced future deterioration. The injection method should provide a more effective repair.

**4.2.3** **Seal Panels -** Although our leak testing did not indicate a porosity problem with the panels, we suggest that the precast panels be pressure washed to remove dirt and then have a silane-based clear penetrating sealer applied to help seal the concrete from water and other contaminant infiltration. This is a maintenance item and should be budgeted every 4 to 6 years.

# 4.2 Building 3

**4.2.1** **Sealant Replacement -** Although the flexible sealant and glazing gaskets generally remain in fair condition, there are currently numerous areas of deterioration. A partial or spot repair project will not satisfactorily repair the building. Due to the deficiencies with the window system and the end dam issue, we recommend using a barrier or rain screen approach to repair those windows that leak instead of relying on the current weep system. The idea being that if the water collection and weep components and system are not functional, the window should be made as water-tight as possible to reduce infiltration. Although the barrier system may not be 100% effective, it should reduce the amount of leaks.

Building sealants should be removed and replaced with a suitable silicone sealant. Precast-to-precast, precast-to-metal, glass-to-metal, and the metal-to-metal weep slit joints should be sealed. The Owner may decide to only repair damaged glazing gaskets, but the weep slits cannot be sealed at locations not wet glazed. also, the soft joint below masonry shelf angles and the planter coping stones should be replaced. The replacement of sealants is a maintenance item and should be anticipated on a periodic basis.

**4.2.2** **Repair Panel Cracks -** Flexible sealant used to surface seal cracks in the precast panels does not provide a bonded structural repair to fill the crack void. The cracks should be cleaned, prepared, and then epoxy injected to properly repair the crack and prevent advanced future deterioration. The injection method should provide a more effective repair.

**4.2.3** **Seal Panels -** Although our leak testing did not indicate a porosity problem with the panels, we suggest that the precast panels be pressure washed to remove dirt and then have a silane-based clear penetrating sealer applied to help seal the concrete from water and other contaminant infiltration. This is a maintenance item and should be budgeted every 4 to 6 years.

**4.2.4** **Replace Through-Wall Flashing -** The through-wall flashing at the fitness center area should be removed and replaced with a more durable material with properly detailed end dams, the flashing should be attached with a termination bar and sealed to the block back-up, and the flashing should extend beyond the face of the brick with a drip edge.

**4.2.5 Re-point Brick -** All cracked, spalled, bulged, or deteriorated mortar should be removed and replaced.

**4.2.6 Replace Brick -** All cracked, spalled, bulged, or deteriorated brick should be removed and replaced.

**4.2.7 Seal Brick -** The brick should be pressure washed to remove dirt and then have a silane\siloxane-based clear penetrating sealer applied to reduce water absorption and other contaminant infiltration. This is a maintenance item and should be budgeted every 4 to 6 years.

**4.2.8 Waterproof Planters -** The fiberglass planter tubs at the 1st floor terrace above the fitness center should be removed and inspected for damage, a waterproofing membrane should be installed at the interior of the planter wells and on the exposed structural deck, the planter tubs replaced and sealed.

**4.2.9 1st Floor Terrace Membrane -** The 1$^{st}$ floor terrace flashings should be repaired at a minimum, so as to help prevent water from getting underneath the membrane. If the flashing repairs do not correct the problem and/or it is determined that the waterproofing membrane has failed, we recommend the sand setting bed, drainage board, and membrane at the 1st floor terrace above the fitness center be removed and replaced with a rubberized asphalt membrane and a pedestal paver system. The existing pavers can be reused with the new pedestal system.

# 4.3 Building 4

**4.3.1 Sealant Replacement -** Although the flexible sealant and glazing gaskets generally remain in fair condition, there are currently numerous areas of deterioration. Due to the deficiencies with the window system and the end dam issue, we recommend using a barrier or rain screen approach to repair those windows that leak instead of relying on the current weep system. The idea being that if the water collection and weep components and system are not functional, the window should be made as water-tight as possible to reduce infiltration. Although the barrier system may not be 100% effective, it should reduce the amount of leaks.

Building sealants should be removed and replaced with a suitable silicone sealant. Precast-to-precast, precast-to-metal, glass-to-metal, and the metal-to-metal weep slit joints should be sealed. The Owner may decide to only repair damaged glazing gaskets, but the weep slits cannot be sealed at locations not wet glazed. also, the soft joint below masonry shelf angles should be replaced. The replacement of sealants is a maintenance item and should be anticipated on a periodic basis.

**4.3.2 Repair Panel Cracks -** Flexible sealant used to surface seal cracks in the precast panels does not provide a bonded structural repair to fill the crack void. The cracks should be cleaned, prepared, and then epoxy injected to properly repair the crack and prevent advanced future deterioration. The injection method should provide a more effective and longer lasting repair.

**4.2.3 Seal Panels -** Although our leak testing did not indicate a porosity problem with the panels, we suggest that the precast panels should be pressure washed to remove dirt and then have a silane-based clear penetrating sealer applied to help seal the concrete from water and other contaminant infiltration. This is a maintenance item and should be budgeted every 4 to 6 years.

**4.3.4 Re-point Brick -** All cracked, spalled, bulged, or deteriorated mortar should be removed and replaced.

**4.3.5 Replace Brick -** All cracked, spalled, bulged, or deteriorated brick should be removed and replaced.

**4.2.6 Seal Brick -** The brick should be pressure washed to remove dirt and then have a clear penetrating sealer applied to reduce water absorption and other contaminant infiltration. This is a maintenance item and should be budgeted every 4 to 6 years.

# 5.0 OPINION OF COST

Our opinions of cost for recommended repairs are summarized in the table below. Please note that our opinions of cost are based on our visual observations during the evaluation and are calculated using our experience with similar projects in the Washington Metropolitan Area, available published cost data, and our discussions with experienced local contractors. However, actual costs may vary significantly due to factors such as time of year, accessibility to the site, owner's permitted construction schedule, material costs and availability, and other factors. The estimated repair quantities are based on our limited swing stage drops on the building, review of drawings, and observations form the ground. Therefore, the repair quantities and costs indicated should be used for budgeting purposes only.

| Summary of Repairs | | | |
|---|---|---|---|
| Repair Item | Estimated Repair Quantity | Unit Cost | Opinion of Cost |
| **5.1: BUILDING 2** | | | |
| 5.1.1 Sealant Replacement | 70,000 linear feet (all) | $3.25 per linear foot | $227,500.00 |
| 5.1.2 Repair Panel Cracks | 750 linear feet | $35.00 per linear foot | $26,250.00 |
| 5.1.3 Seal Panels | 83,000 square feet (all) | $1.25 per square foot | $103,750.00 |
| | | Sub-total | $357,500.00 |
| **5.2: BUILDING 3** | | | |
| 5.2.1 Sealant Replacement | 88,000 linear feet (all) | $3.25 per linear foot | $286,000.00 |
| 5.2.2 Repair Panel Cracks | 1,500 linear feet | $35.00 per linear foot | $52,500.00 |
| 5.2.3 Seal Panels | 112,000 square feet (all) | $1.25 per square foot | $140,000.00 |
| 5.2.4 Replace Through-Wall Flashing | 150 linear feet | $130.00 per linear foot | $19,500.00 |
| 5.2.5 Re-point Brick | 1,500 linear feet | $3.00 per linear foot | $4,500.00 |
| 5.2.6 Replace Brick | 50 square feet | $35.00 per square foot | $1,750.00 |
| 5.2.7 Seal Brick | 35,000 square feet (all) | $1.25 per square foot | $43,750.00 |
| 5.2.8 Waterproof Planters | 500 square feet (all) | $35.00 per square foot | $17,500.00 |
| 5.2.9 Replace Terrace Flashing only | 700 linear feet | $50.00 per linear foot | $35,000.00 |
| Opt. Replace Terrace Membrane | 7,200 square feet (all) | $30.00 per square foot | $216,000.00 |
| | Sub-total (including membrane replacement at terrace) | | $781,500.00 |
| | Sub-total (including flashing only repalcement at terrace) | | $600,500.00 |
| | | | |
| 5.3.1 Sealant Replacement | 43,000 linear feet | $3.25 per linear foot | $139,750.00 |
| 5.3.2 Repair Panel Cracks | 1,200 linear feet (all) | $35.00 per linear foot | $42,000.00 |
| 5.3.3 Seal Panels | 69,000 square feet (all) | $1.25 per square foot | $86,250.00 |
| 5.3.4 Re-point Brick | 500 linear feet | $3.00 per linear foot | $1,500.00 |
| 5.3.5 Replace Brick | 30 square feet | $35.00 per square foot | $1,050.00 |
| 5.3.5 Seal Brick | 13999 square feet (all) | $0.25 per square foot | $3,499.75 |
| | | Sub-total | $274,049.75 |
| | | Total | $1,232,049.75 |
| | | 3% mobilization\ demobilization | $36,961.49 |
| | | 6% contingency | $73,922.99 |
| | | 6% Engineering Fees | $73,922.99 |
| | | **Recommended Budget (incl.Bldg. 3 terrace flashing replacement)** | **$1,417,000.00** |

# 6.0 Summary

Facility Engineering Associates, P.C. (FEA) performed an exterior evaluation at Buildings 2, 3, & 4 of the Silver Spring Metro Center in Silver Spring, Maryland in April 2000. The purpose of our evaluation was to identify defects or deficiencies in the exterior sealants, window systems, precast panels, and exterior components at the three buildings. This report includes a summary of our observations, our recommendations for repair, and our opinions of cost.

The building sealants were generally in poor to fair condition with deterioration observed at several locations. The sealants were found cracked, open, chalked, and with new sealant applied over old. Typically, the useful life of urethane sealants is 8 to 12 years and silicone is 14 to 16 years, but varies depending on product used, substrate preparation, and application procedures. Some silicone sealant manufacturers do offer 20-year material warranties on their products. The precast panels had cracks at various locations, with some surface-sealed with flexible sealant. The fitness center area masonry walls and 1st floor terrace waterproofing was found to have several deficiencies, such as improper flashing details, waterproofing membrane failure, and lack of waterproofing at the planters. The window systems at Buildings 3 and 4 had deficiencies and failures in the weep systems.

Based on the conditions observed at the exterior of Buildings 2, 3, & 4 we have made recommendations for various repairs to address noted deficiencies. We have provided our opinion of cost for the recommended repairs. We do not feel that any window related repair alternatives would be a cost effective approach. Although we have attributed deficiencies to leaks, our recommendations may not completely address the leaks experienced at the building.

The Owner may desire to phase the repairs. We recommend that this be done per building to ensure repair consistency. However, costs may increase if work is broken into smaller phases.

Based on discussions with on-site personnel, general observations, and review of leak locations, some of the leaks may be related to roof-related deficiencies. It was indicated that some roof repairs have been completed. We recommend that all roof levels of each building be thoroughly reviewed for deficiencies.

We observed the facades and associated window components to be soiled with dirt and atmospheric pollution, which is typical for buildings in an urban environment. The building, including window frames, precast panels, etc. should be lightly pressure washed periodically to prevent build-up of contaminants and accelerated deterioration.

We understand that an evaluation has been completed indicating that the HVAC systems are operating the building under positive pressure.  Negatively pressurized buildings can draw moisture through small openings in the building envelope via capillary suction and pressure differences and increase the amount of leaks.

This report has been prepared based on our site observations, information presented to us, interviews with on-site personnel, and our experience with similar building systems.  If any information becomes available that is not consistent with the observations or conclusions presented in this report, please present it to us for our evaluation.